Pat nt claims

1. A method for accurately positioning a patient for radiotherapy and/or radiosurgery, comprising the following steps:

    a) the patient is pre-positioned as accurately as possible with respect to a linear accelerator;

    b) at least two x-ray images of the patient and/or one of the parts of his body in the vicinity of the radiation target point are produced from different respective recording angles on a single image recorder;

    c) the x-ray image is spatially localised;

    d) at least one reconstructed image, corresponding to each x-ray image and deriving from a three-dimensional patient scan data set, is produced, the reconstructed images giving the desired image content of the respective x-ray image when the patient is correctly positioned;

    e) the reconstructed images and the x-ray images are superimposed, and the positioning error is determined electronically and/or with computer guidance by way of particular landmarks in the two images; and

    f) the position of the patient is corrected by way of the determined positioning error.

2. The method as set forth in claim 1, wherein the x-ray images are produced in positions defined offset with respect to the pre-positioning, outside of the radiation range of the linear accelerator, the reconstructed images being produced with the same offset.

3. The method as set forth in claim 2, wherein the defined offset is compensated for by correcting the position of the patient.

4. The method as set forth in any one of claims 1 to 3, wherein the x-ray images are produced at an oblique angle on an image recorder spatially arranged horizontally, and projected back onto each respectively defined normal plane, the corresponding reconstructed images being likewise produced in these normal planes.

5. The method as set forth in any one of claims 1 to 4, wherein the patient is pre-positioned by means of a navigation and tracking system with computer and camera guidance, with the aid of artificial, in particular reflecting, arrangements of markers on the patient and on the devices for treatment.

6. The method as set forth in any one of claims 1 to 5, wherein the patient is pre-positioned using markings on the patient's skin, natural landmarks or laser markings.

7. The method as set forth in any one of claims 1 to 6, wherein the x-ray images and the reconstructed images are superimposed by way of natural structures present in the x-ray images and the reconstructed images, in particular bone structures.

8. The method as set forth in any one of claims 1 to 6, wherein the x-ray images and the reconstructed images are superimposed by way of artificial structures present in the x-ray images and the reconstructed images, in particular implanted markers, preferably gold spheres.

9. The method as set forth in claim 7 or 8, wherein the x-ray images and the reconstructed images are superimposed by marking them manually and sliding them over one another on a computer display unit.

10. The method as set forth in claim 7 or 8, wherein the x-ray images and the reconstructed images are superimposed by automatic, computer-guided image fusion.

11. The method as set forth in any one of claims 1 to 10, wherein the reconstructed image/s is/are produced as:
    - Digitally Reconstructed Radiographs (DRRs);
    - Digitally Composited Radiographs (DCRs);
    - MIP images,

or as any two-dimensional image reconstruction from a three-dimensional patient scan data set.

12. The method as set forth in any one of claims 1 to 11, wherein the position of the patient is altered by shifting the patient table, in particular being automatically guided and corrected by a navigation and tracking system with computer and camera guidance, using markers on the patient and on the patient table.

13. The method as set forth in any one of claims 1 to 12, wherein the position of the patient is corrected by manually guiding the table.

14. The method as set forth in any one of claims 1 to 13, wherein a multitude of images over a breathing cycle are produced from each angle, each time x-ray image are produced from the different recording angles, the breath-dependent movement of the markings arranged on the patient or in the vicinity of the radiation target being tracked by a navigation and tracking system with computer and camera guidance and referenced with the dynamic shifting of the target point directly or indirectly (e.g. via implanted markers) visible in the images, in order to take into account the breath-dependent shifting of the target point during irradiation.

15. A device for accurately positioning a patient for radiotherapy and/or radiosurgery, comprising:

a) at least two x-ray sources (2, 3) with which x-ray images of the patient (P) and/or one of the parts of his body in the vicinity of the radiation target point (T) may be produced from respectively different recording angles;

b) a means by which the x-ray image may be spatially localised;

c) a means by which at least one reconstructed image, corresponding to each x-ray image and deriving from a three-dimensional patient scan data set, may be produced;

d) a means by which the reconstructed images and the x-ray images are superimposed, the positioning error being determined electronically

and/or with computer guidance by way of particular landmarks and/or the intensity gradient or the contours in the two images; and

e) a means by which the position of the patient is corrected with respect to a linear accelerator (1) by way of the determined positioning error, characterised in that

f) the device comprises only one image recorder (6), with which the x-ray images of both x-ray sources are produced.

16. The device as set forth in claim 15, characterised in that the image recorder (6) is an image intensifier or detector, in particular comprising amorphous silicon.

17. The device as set forth in claim 15 or 16, characterised in that the image recorder (6) is positioned on a support (5) for a movable patient table (4).

18. The device as set forth in claim 17, characterised in that the image recorder (6) may be moved vertically together with the patient table (4) and the support (5), while it is securely arranged horizontally.

19. The device as set forth in any one of claims 15 to 18, characterised in that the two x-ray sources (2, 3) are arranged respectively over a patient table (4), in particular fixed to the ceiling, and to the side.

20. The device as set forth in any one of claims 15 to 18, characterised in that the two x-ray sources (2, 3) are arranged respectively beneath a patient table (4), and to the side, the image recorder being positioned above the patient table (4).